PS/RF/Note 97-17
3 October 1997

1st October 1997, PSB RF MD report; Lead PB^{53+} acceleration on h = 4 with two cavities in sequential operation

A. Blas

Experiment limitations:

1 GeV maximum energy
(main power supply ready for 1.4 GeV in 3/98 and septa in 3/99)
Vacuum pressure was between 9.8 E-10 bar for the best section and 4 E-9 for the worse.
B field measurement (B train) was doubtful (12 Gauss error ??)

Target:

h= 4 acceleration with the C02 cavity (max frequency = 2 MHz) from injection (4.2 MeV/u, B = 1407 Gauss, f_{rf} = 723 kHz) to 24.3 MeV/u (B = 3400 Gauss, f_{rf} = 1.71 MHz
→ acceleration charge transferred to C04 cavity applying a bunch to bucket operation without any intermediate magnetic flattening until extraction energy at 148 MeV/u
→ synchronisation.

The aimed intensity at 1 GeV is > 2.5 E09 charges with a < 0.02 [eV.s/u] longitudinal emittance per bunch.

Results:

300 E07 particles (peak value) accelerated with C02 and C04 at 8 kV.
Bunch length at extraction = 70 ns .

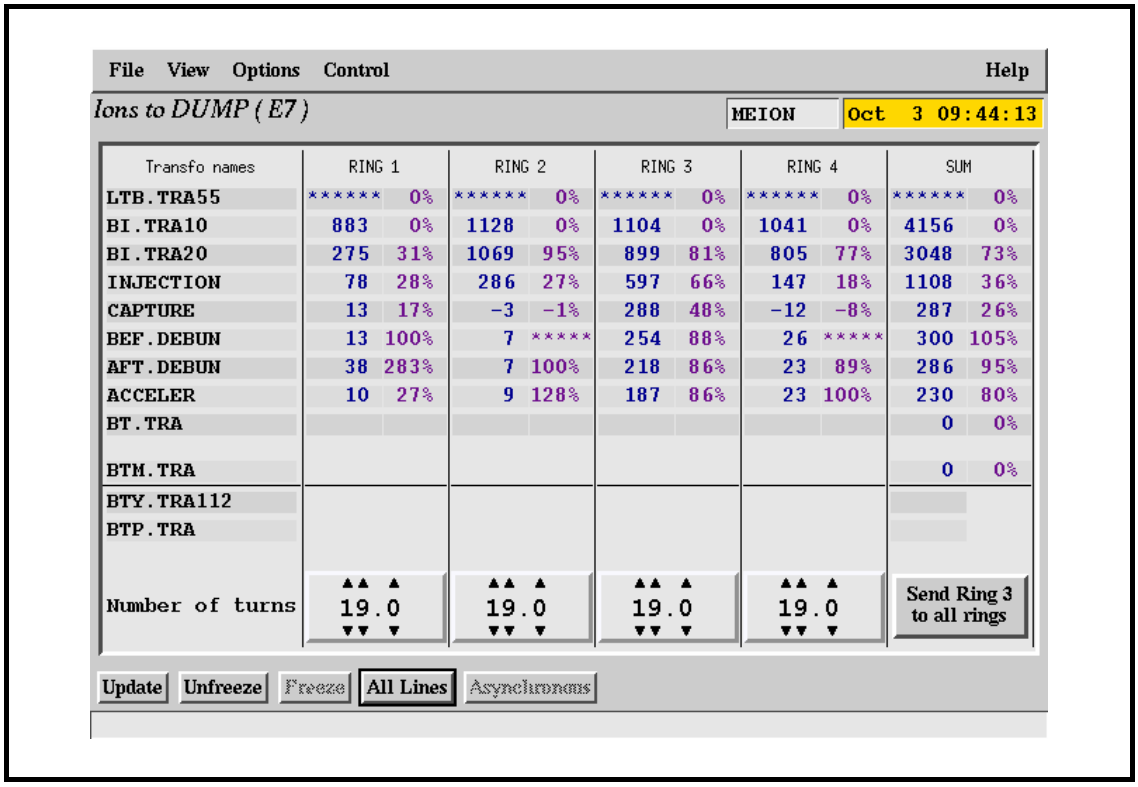


Figure 1: Beam intensities (bad shot obtained just after a one day problem in the Linac - and no time to set the working conditions to get the 300 E7 obtained 2 days before)

The results of this machine development were obtained using the hardware represented in figure 2.

Glossary:

TBU1: B train (one pulse for each Gauss)
BTI: B Train Interface (gives a dummy 0.1 Gauss train and has a few logical functions)
DFP: Digital Frequency program (revolution frequency look-up table)
DAU: Digital Arithmetic Unit (multiplies the revolution word by h)
DLP: Digital Loop Processor (sums the digitised analogue input with the rf frequency word)
DDS: Direct Digital Synthesiser (transforms the digital word in a rf sine-wave)
PLA: Phase Loop Amplifier (phase loop corrector)
SHC: Second Harmonic Corrector

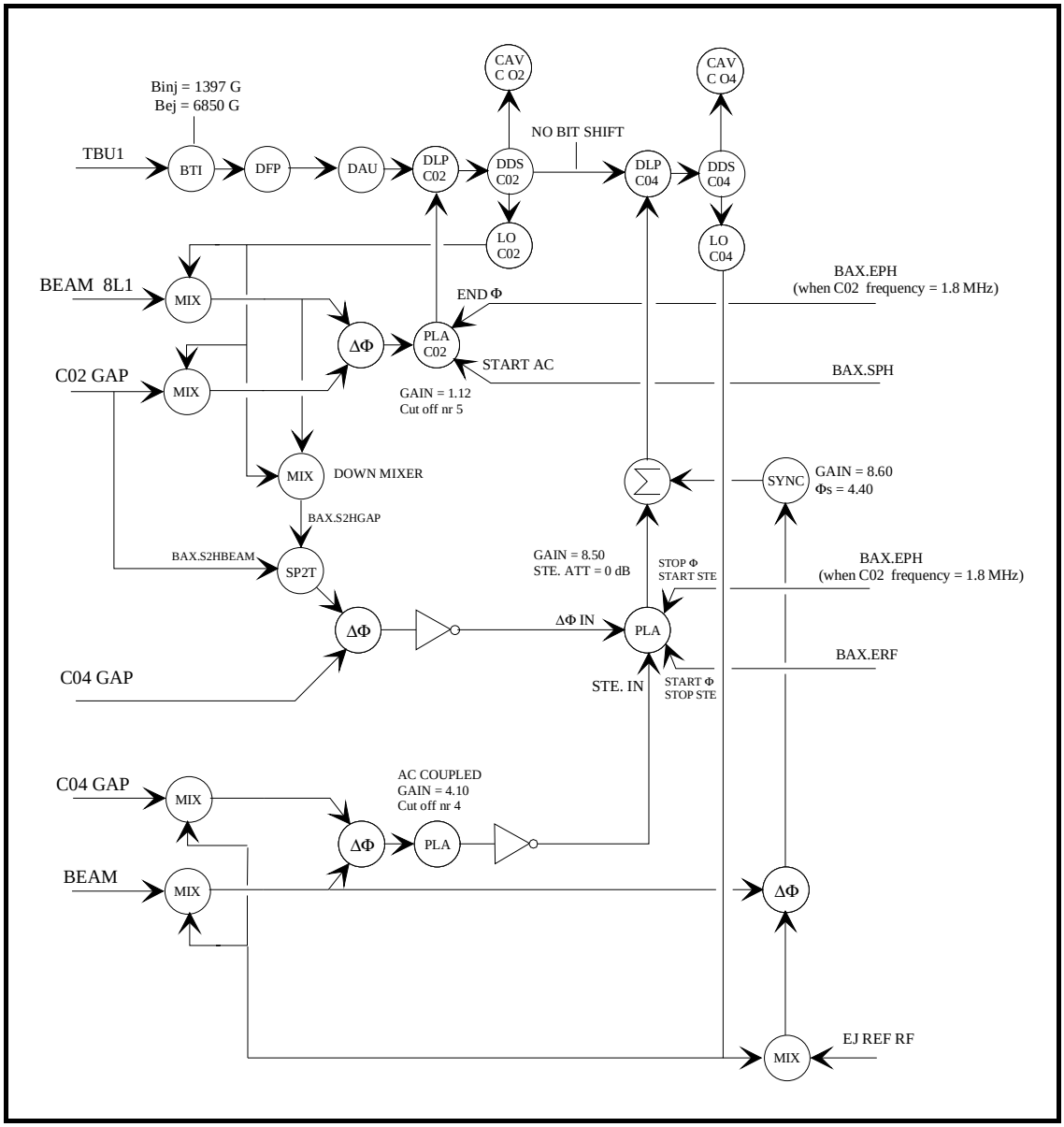


Figure 2: Hardware used for the sequential acceleration of a lead beam.

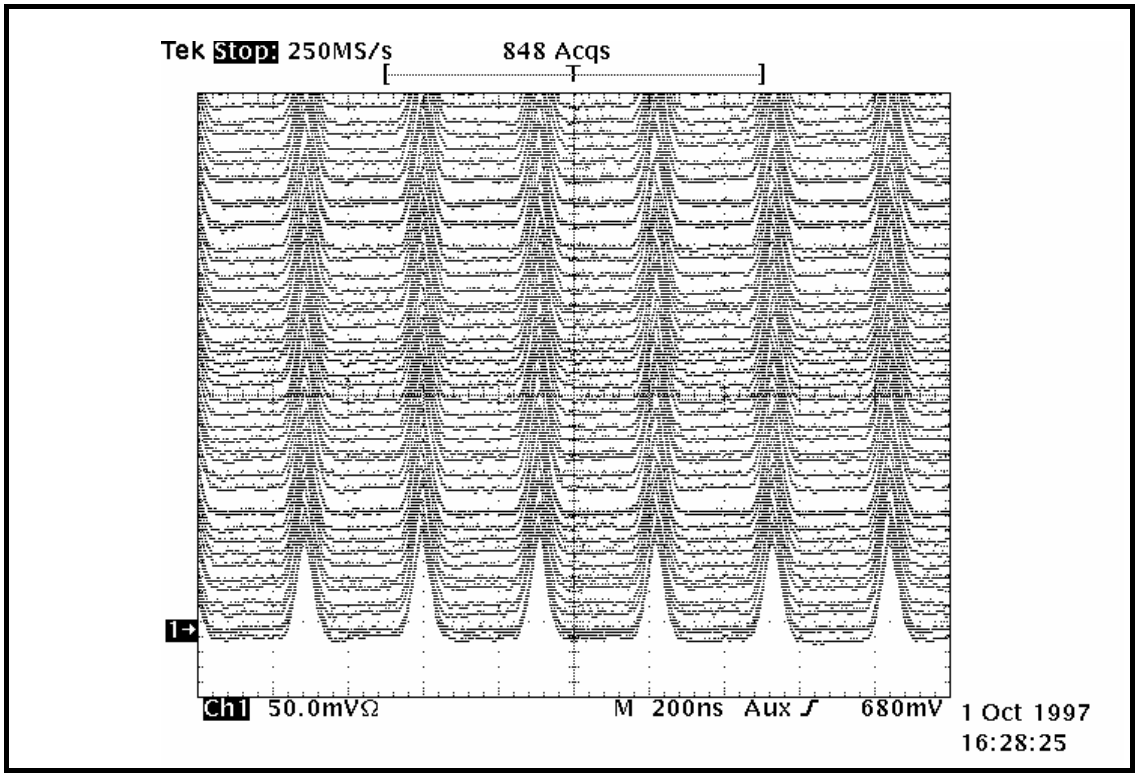


Figure 3: Beam at extraction flat top
Start = BX.SLFT
Scan every 100 revolutions (≡ each 36 μs)
Intensity = 250 E 7 cpp (19 turns injected)

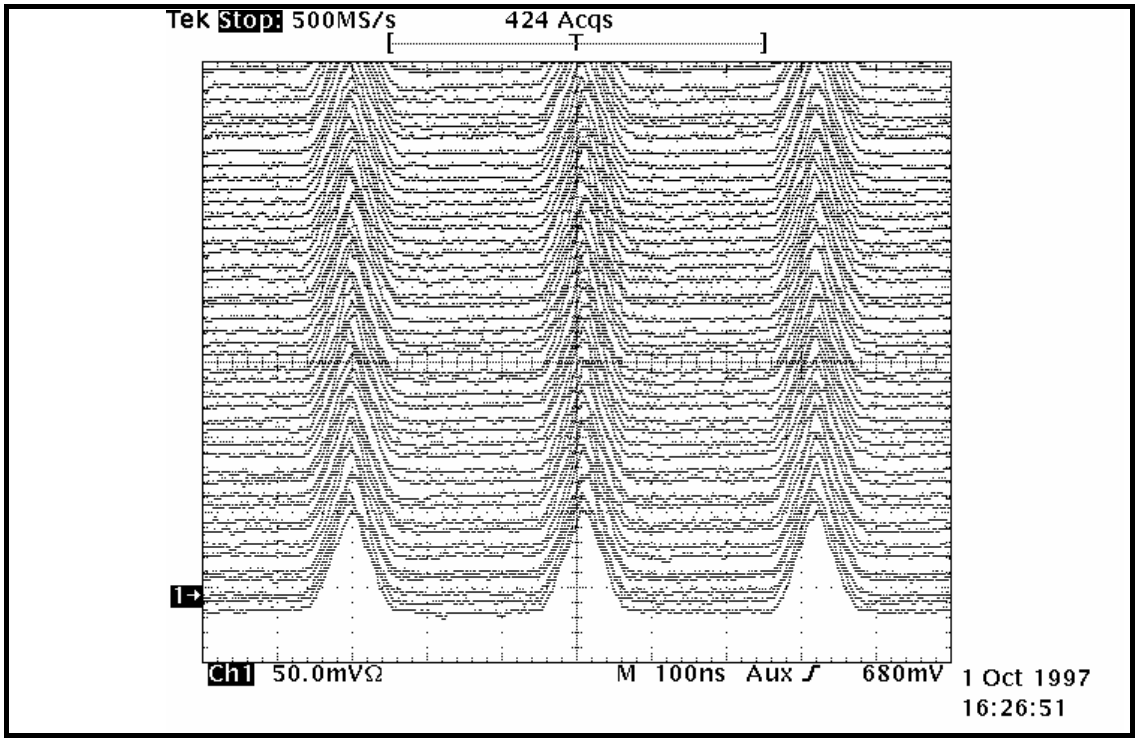


Figure 4: Beam at extraction flat top
Start = BX.SLFT
Scan every 100 revolutions (≡ each 36 μs)
Intensity = 250 E 7 cpp (19 turns injected)

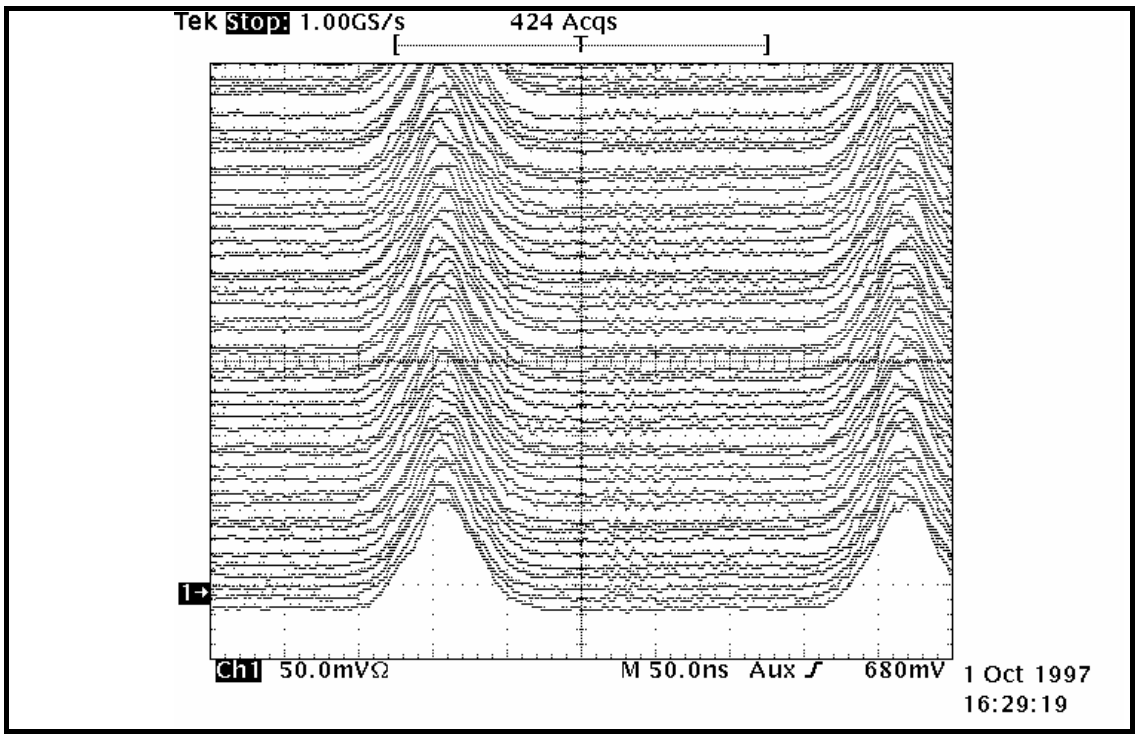


Figure 5: Beam at extraction flat top
Start = BX.SLFT
Scan every 100 revolutions (≡ each 36 μs)
Intensity = 250 E 7 cpp (19 turns injected)

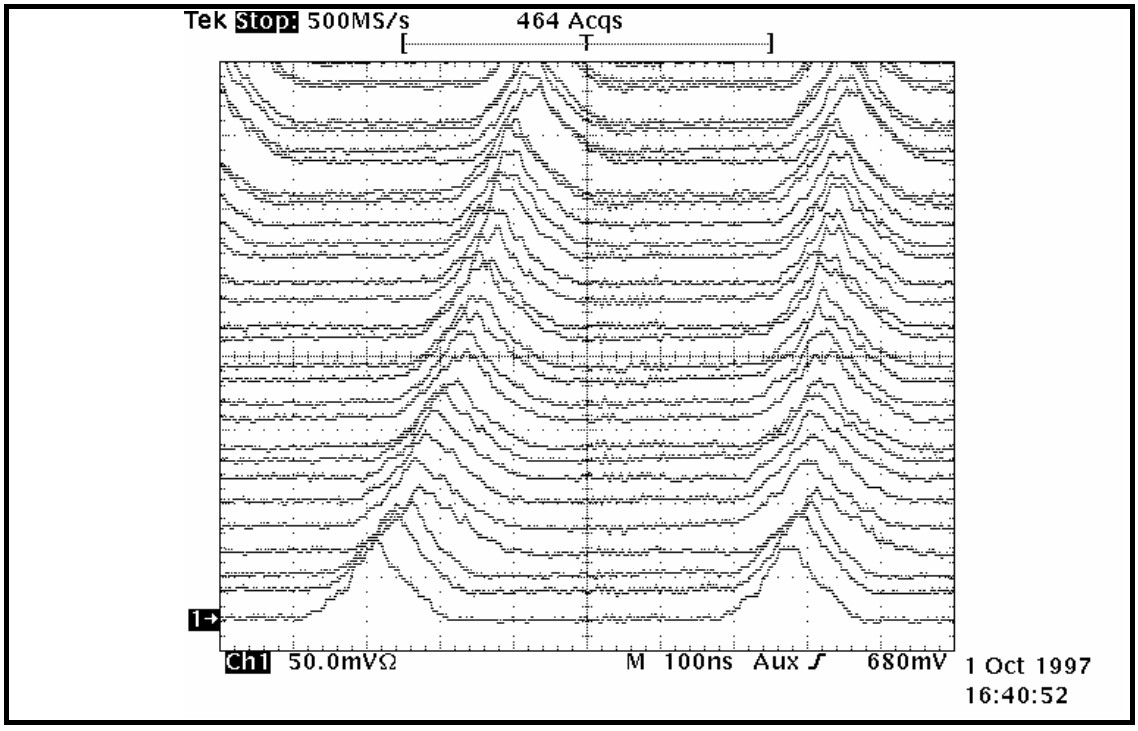


Figure 6: Beam during bunch to bucket operation
Start = Inj + 75 ms
Scan every 1000 revolutions (≡ each 2.2 ms)
Intensity = 250 E 7 cpp (19 turns injected)
f_{rf} = 1.8 MHz

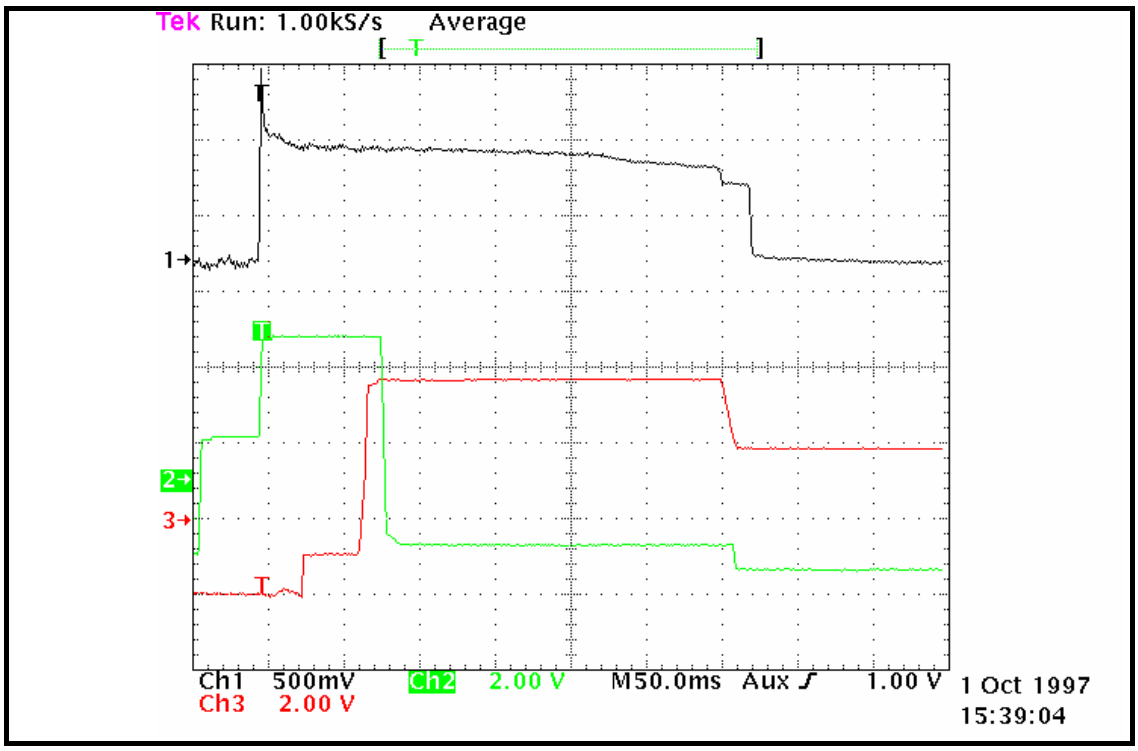


Figure 7: Trace1: Beam current (4 E 9 /V)
Trace 2: Voltage program C02
Trace 3: Voltage program C04
Trig = C205 (injection)

Note that losses 20 ms before extraction are due to a drop in the magnetic field (not resolved during the short MD.

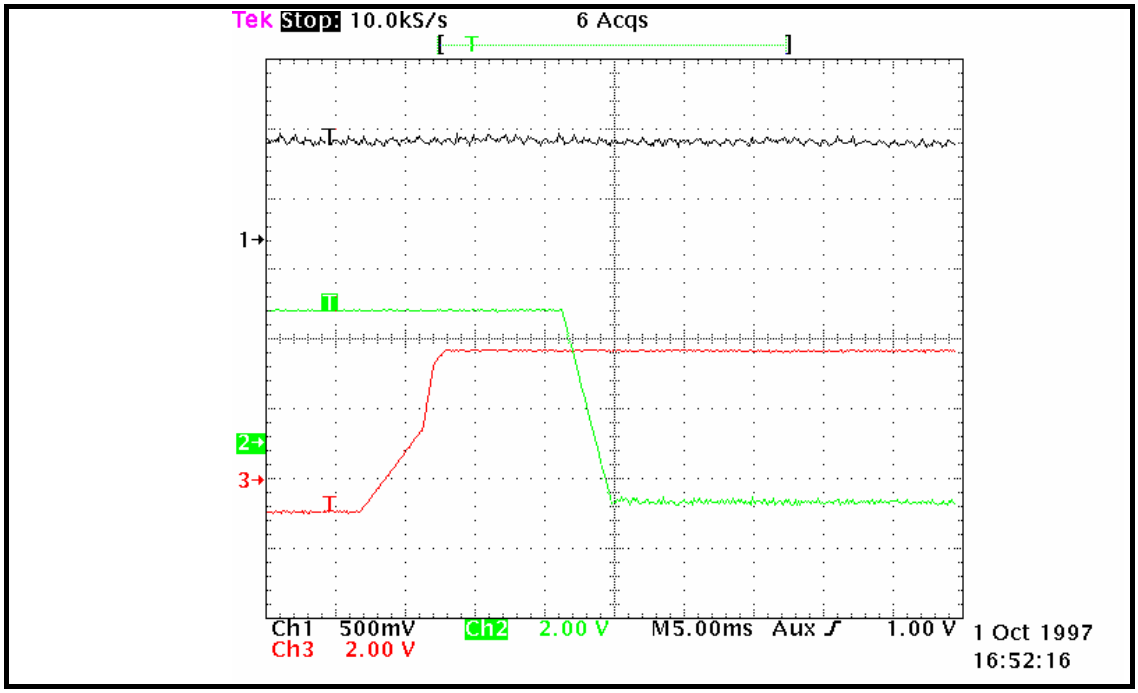


Figure 8: Trace1: Beam current (4 E 9 /V)
Trace 2: Voltage program C02
Trace 3: Voltage program C04
Trig = C265 (injection + 60 ms)

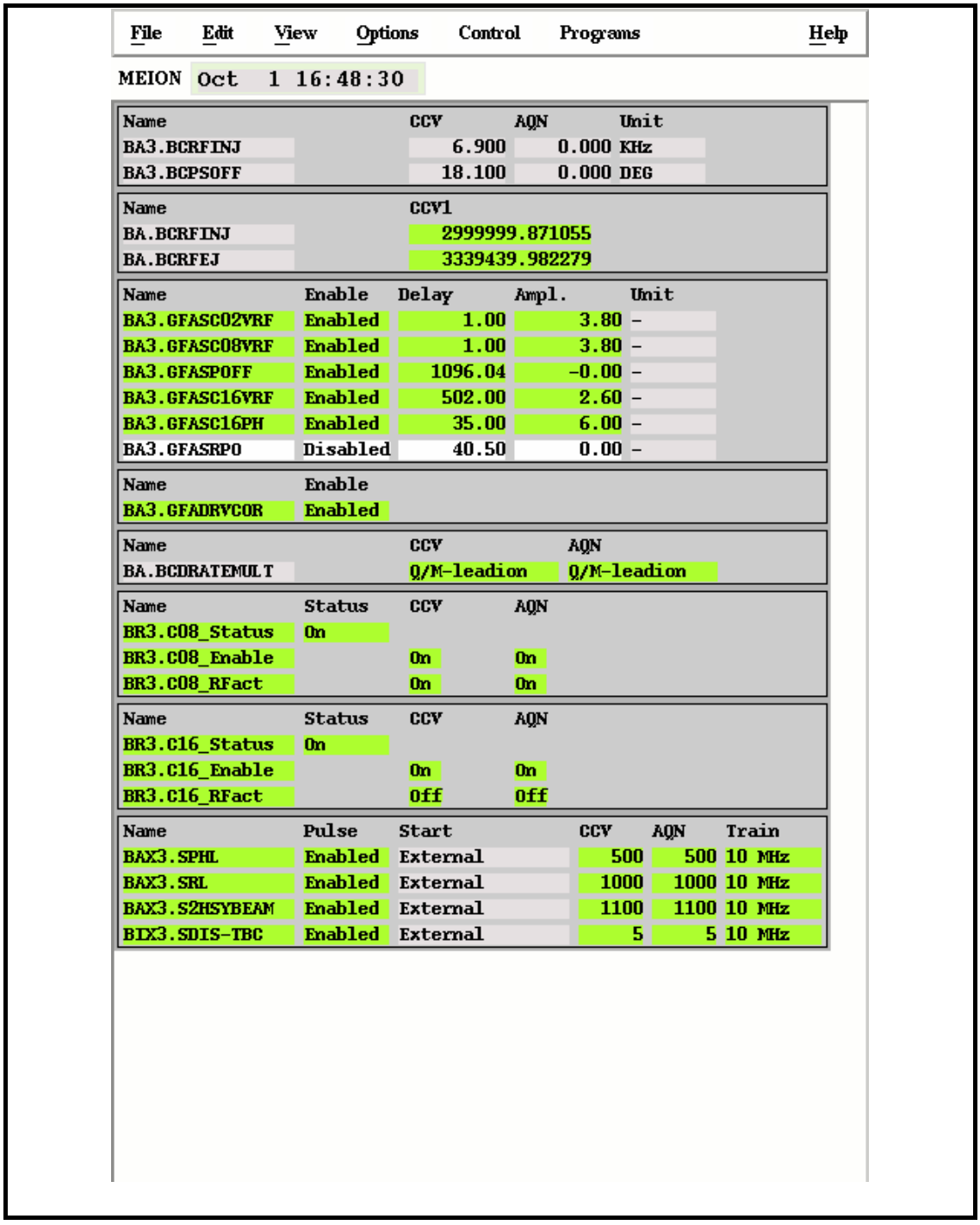
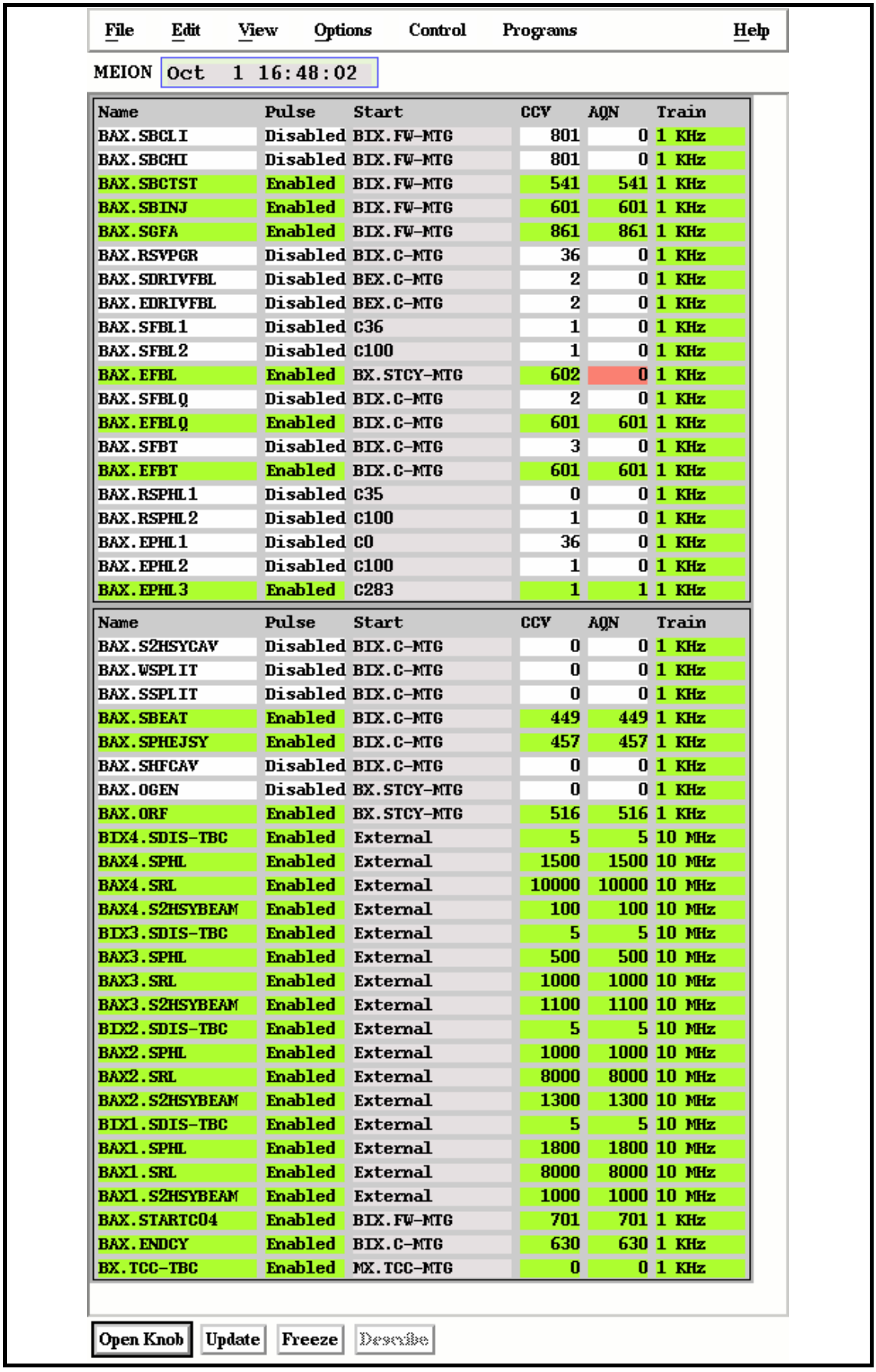


Figure 9: RF RING 3 working set as shown on the console.



Name	Pulse	Start	CCV	AQN	Train
BAX.SBCLI	Disabled	BIX.FW-MTG	801	0	1 KHz
BAX.SBCHI	Disabled	BIX.FW-MTG	801	0	1 KHz
BAX.SBCTST	Enabled	BIX.FW-MTG	541	541	1 KHz
BAX.SBINJ	Enabled	BIX.FW-MTG	601	601	1 KHz
BAX.SGFA	Enabled	BIX.FW-MTG	861	861	1 KHz
BAX.RSVPGR	Disabled	BIX.C-MTG	36	0	1 KHz
BAX.SDRIVFBL	Disabled	BEX.C-MTG	2	0	1 KHz
BAX.EDRIVFBL	Disabled	BEX.C-MTG	2	0	1 KHz
BAX.SFBL1	Disabled	C36	1	0	1 KHz
BAX.SFBL2	Disabled	C100	1	0	1 KHz
BAX.EFBL	Enabled	BX.STCY-MTG	602	0	1 KHz
BAX.SFBLQ	Disabled	BIX.C-MTG	2	0	1 KHz
BAX.EFBLQ	Enabled	BIX.C-MTG	601	601	1 KHz
BAX.SFBT	Disabled	BIX.C-MTG	3	0	1 KHz
BAX.EFBT	Enabled	BIX.C-MTG	601	601	1 KHz
BAX.RSPHL1	Disabled	C35	0	0	1 KHz
BAX.RSPHL2	Disabled	C100	1	0	1 KHz
BAX.EPHL1	Disabled	C0	36	0	1 KHz
BAX.EPHL2	Disabled	C100	1	0	1 KHz
BAX.EPHL3	Enabled	C283	1	1	1 KHz

Name	Pulse	Start	CCV	AQN	Train
BAX.S2HSYCAV	Disabled	BIX.C-MTG	0	0	1 KHz
BAX.WSPLIT	Disabled	BIX.C-MTG	0	0	1 KHz
BAX.SSPLIT	Disabled	BIX.C-MTG	0	0	1 KHz
BAX.SBEAT	Enabled	BIX.C-MTG	449	449	1 KHz
BAX.SPHEJSY	Enabled	BIX.C-MTG	457	457	1 KHz
BAX.SHFCAV	Disabled	BIX.C-MTG	0	0	1 KHz
BAX.OGEN	Disabled	BX.STCY-MTG	0	0	1 KHz
BAX.ORF	Enabled	BX.STCY-MTG	516	516	1 KHz
BIX4.SDIS-TBC	Enabled	External	5	5	10 MHz
BAX4.SPHL	Enabled	External	1500	1500	10 MHz
BAX4.SRL	Enabled	External	10000	10000	10 MHz
BAX4.S2HSYBEAM	Enabled	External	100	100	10 MHz
BIX3.SDIS-TBC	Enabled	External	5	5	10 MHz
BAX3.SPHL	Enabled	External	500	500	10 MHz
BAX3.SRL	Enabled	External	1000	1000	10 MHz
BAX3.S2HSYBEAM	Enabled	External	1100	1100	10 MHz
BIX2.SDIS-TBC	Enabled	External	5	5	10 MHz
BAX2.SPHL	Enabled	External	1000	1000	10 MHz
BAX2.SRL	Enabled	External	8000	8000	10 MHz
BAX2.S2HSYBEAM	Enabled	External	1300	1300	10 MHz
BIX1.SDIS-TBC	Enabled	External	5	5	10 MHz
BAX1.SPHL	Enabled	External	1800	1800	10 MHz
BAX1.SRL	Enabled	External	8000	8000	10 MHz
BAX1.S2HSYBEAM	Enabled	External	1000	1000	10 MHz
BAX.STARTC04	Enabled	BIX.FW-MTG	701	701	1 KHz
BAX.ENDCY	Enabled	BIX.C-MTG	630	630	1 KHz
BX.TCC-TBC	Enabled	MX.TCC-MTG	0	0	1 KHz

Figure 10: RF TIMING working set as displayed on a console

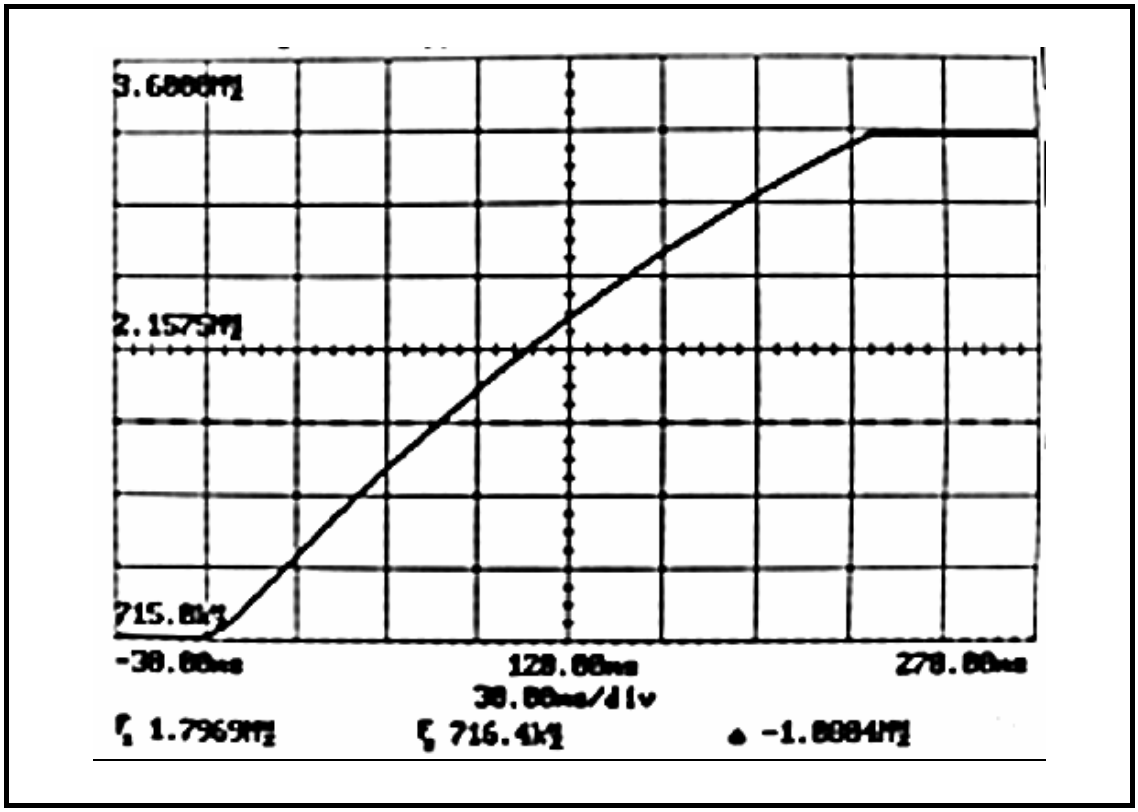


Figure 11: Frequency versus time during the accelerating cycle

Distribution:

PS/RF/LL section
PSB machine supervisors
PSB operation team